# The availability of acute care resources to treat major trauma in different income settings: a self-reported survey of acute care providers

by

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Master of Medicine Emergency Medicine

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## Abstract

Introduction: Injury and violence is a neglected global health problem, despite being largely predictable and therefor preventable. This study aimed to indirectly describe and compare the availability of resources to manage major trauma between high income, and low- to middle-income countries, as self-reported by delegates at the 2016 International Conference on Emergency Medicine held in Cape Town, South Africa.

Materials and methods: A survey was distributed to delegates at the International Conference on Emergency Medicine 2016, Cape Town to achieve the study aim. The survey instrument was based on the 2016 NICE guidelines for the management of patients with major trauma. It captured responses from participants working in both both pre- and in-hospital settings. Responses were grouped according to income group (either high income, or low- to middle-income) based on the responding delegate's nationality (using the World Bank definition for income group). A Fisher's Exact test was conducted to compare delegate responses

Results: The survey was distributed and opened by 980 delegates, of whom 392 (40%) responded. A total of 206 (53%) respondents were from high-income countries and 186 (47%) were from low- to middle-income countries. Responders of this self-reported survey described a significant discrepancy between the resources and services available to high-income countries s and low- to middle-income countries to adequately care for major trauma patients both pre- and in-hospital. Shortages ranged from consumables to analgesia, imaging to specialist services, pre-hospital to in-hospital.

Discussion: Resource restriction is a major concern in the care for major trauma patients in low- to middle-income countries. Current accepted reference standards does not take the resource restrictions that apply to the vast majority of the world's injured patients into account. More research is required to describe the problem of resource restrictions in low-to middle-income countries, and then working out how to overcome it.

## Table of contents

## List of figures



## List of tables

## List of abbreviations

| | |
|---|---|
| APACHE | Acute Physiology And Chronic Health Evaluation |
| EMS | Emergency Medical Services |
| GDP | Gross Domestic Product |
| HIC | High Income Country |
| LIC | Low Income Country |
| LMIC | Low-Middle Income Country |
| NICE | National Institute for Health and Care Excellence |
| RTA | Road Traffic Accidents |
| RTC | Road Traffic Crashes |
| RTI | Road Traffic Injuries |
| SOFA | Sequential Organ Failure Assessment |
| US $ | United States Dollar |
| WHO | World Health Organization |

## Part A: Literature review

### Aim of targeted literature review

The aim of this brief, targeted literature review is to summarize what is known about the availability and distribution of resources available for the acute care of trauma. In particular the review will aim to describe these in terms of the World Bank's low, middle low, middle high and high income groupings. This review will provide a basis for the research paper that follows in the next chapter.

### Literature search strategy including inclusion, exclusion and quality criteria

The literature search strategy consisted of a using a variety of online medical and scientific databases including PubMed, NBCI, Google Scholar, and EMBASE, to maximize yield of relevant references to this study. Searches were conducted using MeSH words, which included "trauma", "Injury", "injury prevention", "low-income", "high-income", "middle-income", "lower-middle", "higher-middle", "LMIC", "Africa", "HIC" "differences", "improvement methods". The relevant abstracts and titles of studies identified from the search were obtained and reviewed individually. Those that could not be obtained from the online library were excluded. Only the English abstracts and papers were reviewed, other language-journals were excluded. More references were identified from the already chosen references and also reviewed and included. Included papers were limited to papers published after 2000, except where the content proved to be of interest. The MMed literature review does not require a formal assessment of the quality of papers and this was therefore not done.

## Targeted review

### *Understanding the global burden of injury*

Trauma (or injury) is an important cause of mortality globally. [1] It is estimated that an injury-related death occurs every six seconds with around 14,000 people dying from injuries on a daily basis. Thousands more are left injured - most often with a permanent disability. [2] To frame the numbers in a different way, 5 million people die each year as a result of injuries accounting for 9% of the world's deaths, nearly 1.7 times the number of fatalities that result from Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS), tuberculosis and malaria combined. [2] According to the World Health Organization (WHO), road traffic injuries account for 1.3 million deaths annually. Having been the ninth leading cause of disability in 2004, it is expected to rise to the third leading cause of disability worldwide by 2030. It will rise to the seventh leading cause of death by 2030. [2] Road traffic injuries are already the leading cause of death for those aged between 15 and 29 years, with homicide and suicide the fourth and fifth leading causes of death respectively among this group. [2] Among the elderly, falls are the most common cause of injury death. [2] Injury from unintentional trauma worldwide leave over 45 million people each year with moderate to severe disability. [1] It is safe to say that the millions of deaths resulting from injuries are but a small fraction of those injured. Globally, tens of millions of people suffer injuries leading to hospitalisation, emergency department or general practitioner treatment, or treatment that does not involve formal medical care. [2] Many of those who survive their injuries are left with temporary or permanent disabilities – injuries are responsible for an estimated 6% of all years lived with disability. [2]The suffering does not stop at the physical aspect - a number of health consequences result from injuries including depression, taking up smoking and alcohol consumption, use of illicit drugs, suicide, and risky sexual practices-which can lead to cancers, cardiovascular diseases, diabetes, liver disease and other chronic diseases. [2] Injuries are a global financial burden causing considerable economic losses to victims, their families, and nations as a whole. These losses emerge from cost of treatment, including rehabilitation, reduced or lost productivity in the form of wages for those killed or disabled by their injuries, and for family members who need to take time off work to care for the injured. [2]

According to the WHO there are few global estimates of the costs of injury, the estimated annual cost of road traffic injuries is more than United States Dollar (US$) 500 billion, which far exceeds the total global expenditures in developmental assistance. [3] The following

examples show the financial impact of injuries: costs relating to road traffic deaths and injuries amount to approximately 2% Gross Domestic Product (GDP) in some LMIC - these include medical bills, vehicle damage, and lost productivity, and total around US$ 1.9 trillion a year, globally. [2] Costs relating to homicide and suicide showed that these were equivalent to 1.2% of gross domestic product in Brazil, 4% of gross domestic product in Jamaica, and 0.4% of gross domestic product in Thailand. [2] A study conducted in Ghana found that over 40% of families of injury victims reported a decline in family income as a result of the injury, with about 20% forced to borrow money and incur debt to pay for medical treatment. [2] A quarter of families reported a decline in their food consumption as a result of the injury. This further promulgates the cycle of poverty [2]. Of course these countries are low- and middle-income economies. To understand what is meant by high-income versus low- and middle-income, it is important to understand how these terms are defined. The World Bank (2011 stats) defines the different income groups as follows: The poor live on $2 or less daily, low-income on $2.01-10, lower-middle income on $10.01-20, upper-middle income on $20.01-50, and high income on more than $50 a day. To gain an even better perspective, only 7% of the global population live within the high-income category, which means 93% of the global population is under-resourced, still developing (or rather underdeveloped) and more affected by the burden of injury. [4-7]

***The discrepancy between different income level economies and burden of disease***

Injuries are an important public health concern, and remain a growing problem in some countries. [2] The three leading causes of death globally from injuries are road traffic crashes homicide and suicide. [2] Two of the three leading causes of injury deaths – road traffic injuries and falls – are predicted to rise in rank compared to other causes of death. The majority of injury-related deaths (roughly 90% of all injury-related deaths) occur in LMIC. Across the world, an injury death rate, which is a better indicator of risk as they take into consideration the size of the population, are higher in lower-income countries [8,9] than in higher-income countries. [2] Injuries show a strong predilection towards the lower socio-economic statuses. This, essentially, means people from poorer economic backgrounds have higher rates of death from injury and non-fatal injuries than wealthier people. A study in Brazil, found that homicide rates in the poorer areas were higher than those in wealthier areas. [10] This is not only true in the LMIC but holds true for the HIC as well. For example a child from the lowest social class in the United Kingdom is 16 times

more likely to die in a house fire than one from a wealthy family. [2] Factors that contributes to this uneven distribution of injuries include: living, working and travelling in less safe conditions, less focus on prevention efforts in poorer areas, and poorer access to quality emergency trauma care and rehabilitation services. In addition to this, less advantaged families come under great financial pressure that results from injuries. This translates in to a vicious cycle of poverty since poor families are less likely to have the financial resources to cover the costs related to injuries. [2]

***Standards of care for trauma victims in low- and middle-income countries***

Tremendous resources are consumed to care for the injured in LMIC hospitals; whilst doing this, less attention is paid towards acquiring a better understanding of injury prevention or improving trauma systems. Understanding patterns of injuries, demographic characteristics, and areas where injuries occur would shed light on how trauma care can be improved, thus having an impact on disability as well as mortality rates. [11,12] Without this understanding, largely due to a paucity of cost-effectiveness data, funding devoted to trauma and injury programs will remain comparatively low [13]

The disproportionately higher burden of injury in LMICs, coupled with multiple barriers to provide evidence based trauma care, results in poorer outcomes. The difference in mortality rates between HICs and LMICs is reported to be as high as 35% and 63% respectively, primarily owing to the fact that having a prehospital service led to decline in the prehospital deaths – decreasing the overall mortality rate. [14]. Mortality rates have been shown to be higher in low to middle income countries compared to high-income countries. Much can, and still needs to be done to strengthen the prevention and treatment of injuries in the former settings. [15,16] Despite this discrepancy in equipment and specialised services in LMICs, organised trauma systems and better prehospital care would greatly improve service delivery and outcomes. [17] Even though a paucity of data exists on resource availability to implement trauma guidelines in countries with different income categories, it is unlikely that policies and guidelines developed in HIC settings would similarly apply in LMIC settings. [16,18,19,20] The challenge thus lies in implementing internationally accepted guidance, particularly in LMICs where resources are limited, and the population exceeds six billion people. [15,21]

More and more countries are making an effort to understand the burden and impact of trauma in their countries so as to form the foundation for designing, implementing and monitoring effective prevention strategies. In some instances this has shown to be of great financial benefit to the society. For example a study in the US showed that for every dollar spent on smoke detectors one saved US$ 28 in health-related expenditure [22]

But again, most of the evidence comes from HIC, which means LMIC need to strive towards bettering and improving their care for trauma victims, perhaps by implementing some of the evidence based strategies which suit their environment. By doing this, continuously and closely monitoring the outcomes of these efforts, one can hope that it may be possible to lower the current high burden of injury. [2]

***Addressing the burden of trauma***

While the ultimate goal is injury prevention, much can be done to reduce the disability that occurs as the trauma "aftermath". Ensuring that quality care and support is provided to the trauma victims, can prevent fatalities, reduce the amount of short-term and long-term disability, and help those affected to cope with the impact of the violence or injury on their lives. This can be done through thorough planning and implementation of systematically organized programs to better the access and provision of both pre hospital and hospital care. For example, placing more ambulance stations to allow for a more rapid response from prehospital care providers combined with improved training for the providers helped to reduce mortality among trauma patients in Mexico. [23] Thus the key strategies to ensure that injury victims who experience disability manage to live an enjoyable and full life are: providing rehabilitation for these individuals, removing barriers to care, and social and economic participation. [2]

*Trauma guidelines and the National institute for health and care excellence (NICE)*

Studies have shown that management of trauma and the reduction of mortality can be improved when trauma protocols/operating protocols are used. [24] Since the publishing of the WHO's "Essentials of trauma care" in 2004, trauma management has not seen a comprehensive set of guidelines catering to all holistically managing a trauma patient. The NICE major trauma guidelines are the most recent evidence based trauma guidance that is available. It was published in February 2016 – making it a more up to date reference if

compared to the WHO trauma guidelines, albeit a reference made to cater for HIC. [25,26] Unfortunately no recent reference exists for LMIC.

*Studies showing similar trends of resource unavailability in low- and middle-income countries*

Resource constraints are not only limited to the management of major trauma and injuries; this is a well-known problem to all facets of health care practise in LMIC. Baelani et al did a study to compare resources available to implement the severe sepsis guidelines in HIC and LMIC. Their study showed that approximately 25% of the participants did not have an ICU in their hospital, 15% of the participants stated that they did not have an emergency room/centre in their hospital. They further showed that almost all the materials necessary to implement the SSC guidelines were less frequently available for LMIC respondents if compared to those from HIC. LMIC also lacked basic resources such as oxygen and fluids (which are basic essentials in major trauma management as well), essential disposables and monitoring equipment. [27] They concluded by stating that only a small percentage of African respondents (who form part of the LMIC category) had the required facilities, drugs and disposable materials available to implement the SSC guidelines, most of the LMIC category could not implement the SSC guidelines due to a lack of necessary resources; and that the SSC guidelines may need to be modified (based on available resources) so that countries (deficient in resources) could implement them. [27]

Jerome, Laing, Bruce et al [24] in their study on traumatic brain injury (TBI) in a low-resourced trauma service demonstrated that due to inadequate access and resource limitations, majority of patients with severe TBI were not dealt with at an institution with access to specialised neurosurgical services. In addition to that, the majority of the patients that did get accepted to a specialised neurosurgical centre were not managed in the ICU but rather in a general ward. They went on to state that due to limited resources and inadequate access to specialised care, patients with severe TBI who survived after being managed in a general surgical unit may have benefitted from sophisticated neuroprotective strategies available in the ICU. [24]

A very recent study published in 2017 by Baker et al [28] stated that information on critical care capacity in LIC was sparse and that there was insufficient data relating to that. They focussed mostly on the critical care services and availability, however did comment on the critical illness arising from the significant burden of trauma, which largely affects the LIC. They went on to state that trauma patients often present late to the health care centres

due to lack of infrastructure for transport and emergency medical services, and suboptimal care on arrival to hospital, leading to more severe disease. They also demonstrated that shortage of facilities including blood banks and laboratory services; equipment, drugs and disposable materials were a major obstacle in handling critically ill patients in the LIC. In addition to this, hospitals lacked resources to follow international guidelines for sepsis and TBI, there were shortages of treatment routines and trained personnel capable of caring for the critically ill patients which included a low availability of medical technicians to maintain equipment-that was often left lying dormant (because of lack of financial support to buy necessary spare) but could potentially save lives, if they were functional. The study also stated that severity assessment tools such as the Sepsis-related Organ Failure score (SOFA), Acute Physiology and Chronic Health Evaluation (APACHE) were developed in high resource settings and included parameters that were usually unavailable in hospitals in LIC. [28]

A further study by Wong et al [29] demonstrated that despite trauma care having come a long way in LMIC, including the development of the "guidelines for Essential Trauma care" which shed light on various deficiencies in trauma care in the LMIC and therefore provided an opportunity for improvement, there was still a significant deficiency in the management of trauma victims. They demonstrated that resources essential to the initial and definitive management of trauma remained limited despite prior efforts to improve them. Furthermore the study showed that substantial deficiencies exist in the primary care facilities and district hospitals. For example, it was noted that only 33% or less of the facilities were capable of providing basic resuscitation or definitive airway management. Other factors identified as lacking included blood banks and intravenous fluids. The study also attempts at providing a glimpse in to the future for trauma care by raising the point that despite the focus being on reducing trauma mortality, more research is needed to take in to account services available to deal with the morbidity that accompanies trauma victim survivors such as rehabilitation services. [29]

***Conclusion***

The majority of the burden of injuries lies in LMICs, where a lack of financial stability coupled with resource limitations has led to the continuation of the vicious cycle of poverty and thus the growing burden of trauma and injuries. As more awareness regarding this problem is generated, more effort will be required to not only gather information (in the form of data) but also to translate that information down to the community level so as to

improve the well-being of the populations residing in the LMIC and perhaps reducing the burden of injuries.

Although improve trauma care in LMICs is important, resource restriction remains a major obstacle. Current accepted reference standards provide little wiggle room for clinicians working in these difficult circumstances as these are not designed with limited resources in mind. More research is required to describe the resource restrictions that apply to acute trauma care in LMICs, in order to work out how to overcome it – specifically, the development of trauma guidelines that considers the resource restrictions within this setting.

**Need for further research**

- Despite trauma burden being higher in LMIC, most of the research and guidelines come from HIC.
- Since the WHO's guidelines on Trauma care (2004), no recent guidelines have been made to cater for LMIC.
- More data is needed from LMIC to better understand resource limitations and hence gear efforts in to tackling those constraints, and optimise outcomes.
- More research is required to develop specific trauma guidelines that factor in (and provide real-world solutions) for the resource limitations within this setting.

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**Part B: Manuscript**

**Title page (for African Journal of Emergency Medicine)**

# Poor access to acute care resources to treat major trauma in low- and middle-income settings: a self-reported survey of acute care providers

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**Abstract**

**Poor access to acute care resources to treat major trauma in low- and middle-income settings: a self-reported survey of acute care providers**

Introduction: Injury and violence is a neglected global health problem, despite being largely predictable and therefore preventable. This study aimed to indirectly describe and compare the availability of resources to manage major trauma between high income, and low- to middle-income countries, as self-reported by delegates at the 2016 International Conference on Emergency Medicine held in Cape Town, South Africa.

Materials and methods: A survey was distributed to delegates at the International Conference on Emergency Medicine 2016, Cape Town to achieve the study aim. The survey instrument was based on the 2016 NICE guidelines for the management of patients with major trauma. It captured responses from participants working in both both pre- and in-hospital settings. Responses were grouped according to income group (either high income, or low- to middle-income) based on the responding delegate's nationality (using the World Bank definition for income group). A Fisher's Exact test was conducted to compare delegate responses

Results: The survey was distributed and opened by 980 delegates, of whom 392 (40%) responded. A total of 206 (53%) respondents were from high-income countries and 186 (47%) were from low- to middle-income countries. Responders of this self-reported survey described a significant discrepancy between the resources and services available to high-income countries s and low- to middle-income countries to adequately care for major trauma patients both pre- and in-hospital. Shortages ranged from consumables to analgesia, imaging to specialist services, pre-hospital to in-hospital.

Discussion: Resource restriction is a major concern in the care for major trauma patients in low- to middle-income countries. Current accepted reference standards does not take the resource restrictions that apply to the vast majority of the world's injured patients into account. More research is required to describe the problem of resource restrictions in low- to middle-income countries, and then working out how to overcome it.

**African relevance**

- Resource restriction is a major concern for major trauma care in low- and middle-income countries.
- Current accepted reference standards provide little room for clinicians working in these countries.
- More research is required to describe the problem of resource restrictions in LMICs.

**Manuscript**

**Poor access to acute care resources to treat major trauma in low- and middle-income settings: a self-reported survey of acute care providers**

***Introduction***

Injury and violence is a neglected global health problem, despite being largely predictable and therefor preventable. According to the World Health Organisation (WHO), road traffic injuries account for 1.3 million deaths annually and will rise from the ninth leading (2004) to the third leading cause of disability, worldwide by 2030. [1] Road traffic injuries and other forms of trauma are significant health issues in low- to middle-income countries (LMICs), where the burden of death and disability is most notable. [2-4] The disproportionately higher burden in LMICs, coupled with multiple barriers to provide evidence-based trauma care, results in poorer outcomes. [5-7] Even though a paucity of data exists on resource availability to implement trauma guidelines in countries with different income categories, it is unlikely that policies and guidelines developed in high-income country (HIC) settings would similarly apply in LMIC settings. [8,9] The challenge thus lies in knowledge translation of internationally accepted guidance, particularly for the outsized proportion of the global population living in LMICs, where resources are limited. [7]

We conducted a small study to indirectly describe and compare the availability of resources to manage major trauma in HICs and LMICs as self-reported by delegates at the 2016 International Conference on Emergency Medicine held in Cape Town, South Africa.

***Methods***

An electronic survey was distributed to delegates at the International Conference on Emergency Medicine 2016, Cape Town to achieve the study aim. The survey instrument was based on the 2016 National Institute of Clinical Excellence (NICE) guidelines for the management of patients with major trauma. [2][3] The survey captured both resource availability in the pre-hospital and in-hospital settings and was piloted prior to use in the study. It is available as Appendix A (data supplement). Descriptive statistics were used to describe the study variables for both the pre-hospital and in-hospital parts of the survey. Responses were grouped according to income group (either HIC or LMIC) based on the responding delegate's nationality (using the World Bank definition for income group). A Fisher's Exact test was conducted to compare HIC and LMIC delegate responses. Key

findings are presented in table format using the key recommendations of the 2016 NICE guidelines for the management of patients with major trauma as a guide. More detailed findings are available as Appendix B (data supplement). The study received ethical approval from the University of Cape Town Human Research Ethics Committee (110/2016).

***Results***

The survey was distributed and opened by 980 delegates, of whom 392 (40%) responded. A total of 206 (53%) respondents were from HICs and 186 (47%) were from LMICs. Male respondents accounted for 223 (57%) of respondents and the mean age of the sample was 42 years (SD=10.67 years). A higher proportion of specialist physicians were from HICs (160, 78%) versus LIMCs (90, 48%) (p=<0.0001). The majority of respondents, from both groups, worked in the public sector: 165 (80%) from HICs and 115 (62%) from LMICs (p<0.0001). A greater proportion of LMIC respondents worked in privately-funded institutions: 48 (26%) versus HICs 12 (6%) (p<0.0001). More than half of the respondents (220, 56%) worked in a tertiary institution, of which 133 (60%) were from HICs and 87 (40%) from LMICs. A higher proportion of LMIC respondents, compared to HIC respondents, reported the lack of a prehospital service in their region – 79% versus 21% respectively. Of the 392 delegates that responded, 105 (27%) indicated that they practised in a prehospital setting. Table 1 provides the self-reported pre- and in-hospital resource and service availability, as described against the NICE Major trauma: assessment and initial management guideline between delegates from high-income countries and low- and middle-income countries. Figures 1 and 2 provide a visualisation of self-reported pre- and in-hospital resource and service availability, ranked for reported availability of delegates from low- and middle-income countries, compared with those of high-income countries

Table 1: Self-reported pre- and in-hospital resource and service availability, as described against the NICE Major trauma: assessment and initial management guideline between delegates from high-income countries (pre-hospital n=40, in-hospital n=175) and low- and middle-income countries (pre-hospital n=65, in-hospital n=150)

| High income countries | | | | | | | | | Low- and middle-income countries | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Always | | Sometimes | | Never | | Do not know | | Resource or service variables | Always | | Sometimes | | Never | | Do not know | |
| **Immediate destination after injury** | | | | | | | | | | | | | | | | |
| 37 | 93% | 2 | 5% | 1 | 3% | - | - | Pre-hospital triage Protocol*** | 40 | 62% | 22 | 34% | 3 | 5% | - | - |
| 36 | 90% | 3 | 8% | - | - | 1 | 3% | Pre-arrival Major Trauma Notification Protocol*** | 19 | 29% | 39 | 60% | 6 | 9% | 1 | 2% |
| 126 | 72% | 9 | 5% | 5 | 3% | 35 | 20% | In-hospital Major Trauma Activation Protocol*** | 38 | 25% | 28 | 19% | 39 | 26% | 45 | 30% |
| **Airway management in pre-hospital and hospital settings** | | | | | | | | | | | | | | | | |
| 33 | 83% | 2 | 5% | 3 | 8% | 2 | 5% | Pre-hospital rapid sequence induction: sedation*** | 25 | 38% | 23 | 35% | 14 | 22% | 3 | 5% |
| 24 | 60% | 8 | 20% | 6 | 15% | 2 | 5% | Pre-hospital rapid sequence induction: muscle relaxant** | 21 | 32% | 33 | 51% | 9 | 14% | 2 | 3% |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | 88% | 4 | 10% | 1 | 3% | - | - | Pre-hospital supraglottic airways (e.g. laryngeal mask)*** | 30 | 46% | 21 | 32% | 13 | 20% | 1 | 2% |
| 173 | 99% | 1 | 1% | - | - | 1 | 1% | In-hospital rapid sequence induction: sedation*** | 134 | 89% | 11 | 7% | 5 | 3% | - | - |
| 173 | 99% | 1 | 1% | - | - | 1 | 1% | In-hospital rapid sequence induction: muscle relaxant*** | 129 | 86% | 14 | 9% | 5 | 3% | 2 | 1% |
| 175 | 100% | - | - | - | - | - | - | In-hospital endotracheal tube*** | 139 | 93% | 9 | 6% | 1 | 1% | 1 | 1% |
| **Management of chest trauma in pre-hospital and hospital settings** | | | | | | | | | | | | | | | | |
| 28 | 70% | 5 | 13% | 4 | 10% | 3 | 8% | Pre-hospital chest injury management guideline*** | 17 | 26% | 30 | 46% | 13 | 20% | 5 | 8% |
| 40 | 100% | - | - | - | - | - | - | Pre-hospital IV cannula** | 52 | 80% | 11 | 17% | 2 | 3% | - | - |
| 19 | 48% | 10 | 25% | 9 | 23% | 2 | 5% | Pre-hospital thoracostomy (chest drain) set*** | 12 | 18% | 13 | 20% | 38 | 58% | 2 | 3% |
| 170 | 97% | 3 | 2% | 1 | 1% | 1 | 1% | In-hospital thoracostomy (chest drain) set** | 133 | 89% | 13 | 9% | 4 | 3% | - | - |
| 156 | 89% | 17 | 10% | 2 | 1% | - | - | In-hospital imaging: Ultrasound* | 116 | 77% | 28 | 19% | 6 | 4% | - | - |
| 173 | 99% | 2 | 1% | - | - | - | - | In-hospital imaging: Plain film radiology: x-rays** | 137 | 91% | 13 | 9% | - | - | - | - |
| 169 | 97% | 3 | 2% | 3 | 2% | - | - | In-hospital imaging: Computed Tomography Scanner (CT-scan)*** | 97 | 65% | 33 | 22% | 19 | 13% | 1 | 1% |

| Management of haemorrhage in pre-hospital and hospital settings | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | 78% | 7 | 18% | 2 | 5% | - | - | Pre-hospital tourniquets | 35 | 54% | 24 | 37% | 6 | 9% | - | - |
| 31 | 78% | 5 | 13% | 4 | 10% | - | - | Pre-hospital pelvic binder*** | 18 | 28% | 28 | 43% | 18 | 28% | 1 | 2% |
| 12 | 30% | 11 | 28% | 17 | 43% | - | - | Pre-hospital Tranexamic acid (Cyclokapron®)* | 8 | 12% | 10 | 15% | 46 | 71% | 1 | 2% |
| 38 | 95% | 2 | 5% | - | - | - | - | Pre-hospital IV fluids: Isotonic crystalloids (e.g. Saline) | 53 | 82% | 10 | 15% | 1 | 2% | 1 | 2% |
| 164 | 94% | 3 | 2% | 4 | 2% | 4 | 2% | In-hospital tourniquets*** | 107 | 71% | 27 | 18% | 15 | 10% | 1 | 1% |
| 154 | 88% | 11 | 6% | 7 | 4% | 3 | 2% | In-hospital pelvic binder*** | 73 | 49% | 37 | 25% | 34 | 23% | 6 | 4% |
| 160 | 91% | 6 | 3% | 2 | 1% | 7 | 4% | In-hospital Tranexamic acid (Cyclokapron®)*** | 111 | 74% | 25 | 17% | 11 | 7% | 3 | 2% |
| 129 | 74% | 6 | 3% | 4 | 2% | 36 | 21% | In-hospital major haemorrhage protocol*** | 39 | 26% | 24 | 16% | 39 | 26% | 48 | 32% |
| 171 | 98% | 1 | 1% | 3 | 2% | - | - | In-hospital packed red cells*** | 117 | 78% | 29 | 19% | 4 | 3% | - | - |
| 171 | 98% | 1 | 1% | 3 | 2% | - | - | In-hospital fresh frozen plasma (or freeze dried plasma)*** | 102 | 68% | 37 | 25% | 11 | 7% | - | - |
| 163 | 93% | 8 | 5% | 4 | 2% | - | - | In-hospital platelets*** | 87 | 58% | 44 | 29% | 18 | 12% | 1 | 1% |
| 163 | 93% | 11 | 6% | 1 | 1% | - | - | In-hospital surgical service (including theatre)*** | 116 | 77% | 31 | 21% | 3 | 2% | - | - |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | (see ultrasound, x-ray and CT scan availability above) | | | | | | | | | |
| **Pain management in pre-hospital and hospital settings** | | | | | | | | | | | | | | | | | |
| 17 | 43% | 9 | 23% | 12 | 30% | 2 | 5% | Pre-hospital analgesia: Morphine*** | 8 | 12% | 15 | 23% | 39 | 60% | 3 | 5% |
| 33 | 83% | 1 | 3% | 6 | 15% | - | - | Pre-hospital analgesia: Ketamine*** | 29 | 45% | 26 | 40% | 7 | 11% | 3 | 5% |
| 174 | 99% | 1 | 1% | - | - | - | - | In-hospital analgesia: Morphine | 133 | 89% | 12 | 8% | 5 | 3% | - | - |
| 169 | 97% | 5 | 3% | 1 | 1% | - | - | In-hospital analgesia: Ketamine*** | 137 | 91% | 10 | 7% | 3 | 2% | - | - |

*, p<0.05; **, p<0.01; p<0.001

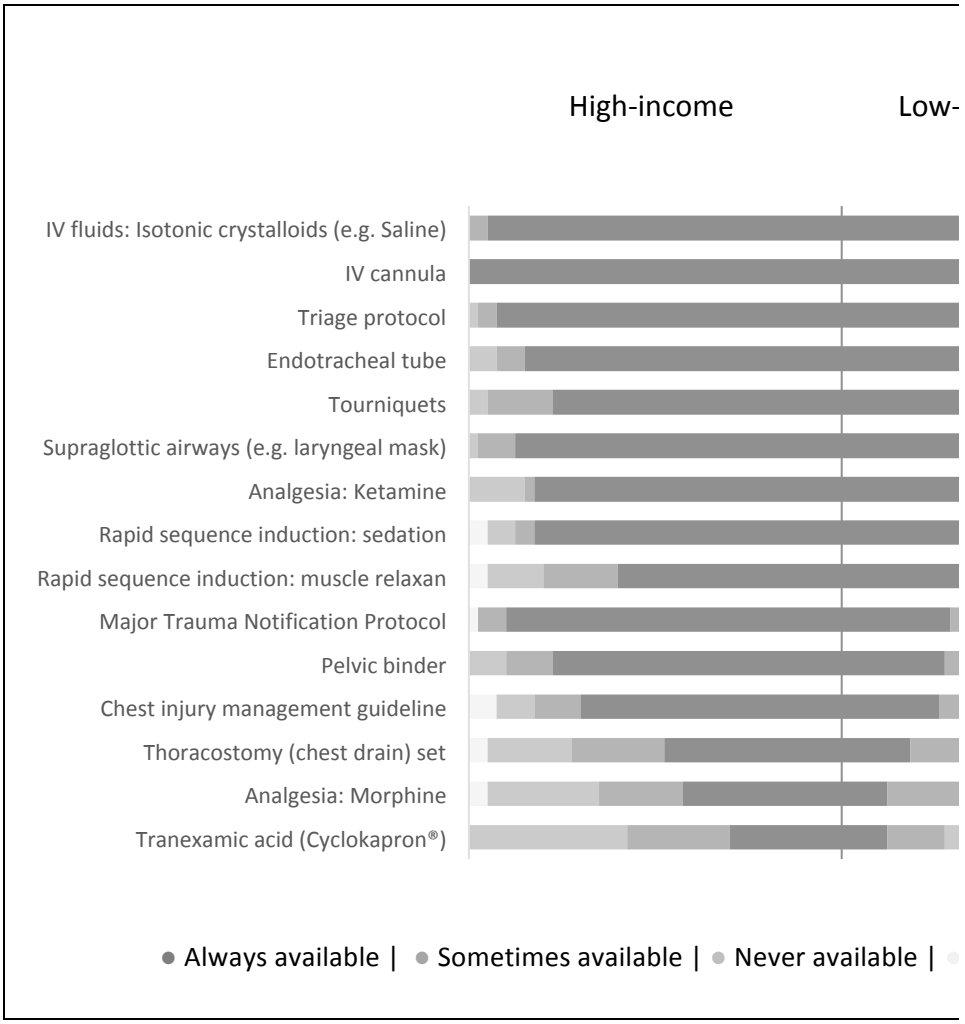


Figure 1. Visualisation of self-reported **pre-hospital** resource and service availa
for reported availability of delegates from low- and middle-income countri
with those of high-income countries

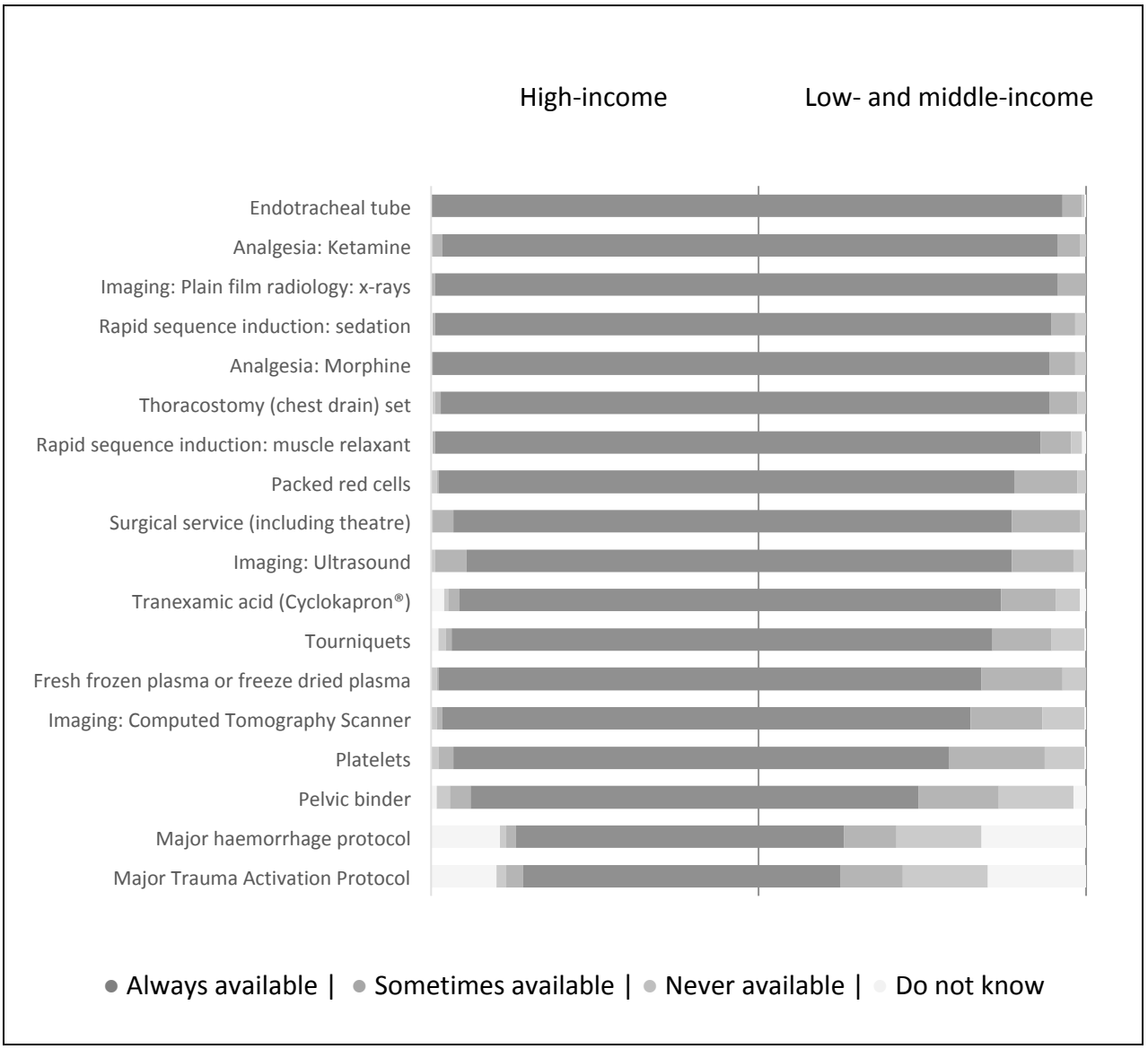


Figure 2. Visualisation of self-reported in-hospital resource and service availability, ranked for reported availability of delegates from low- and middle-income countries, compared with those of high-income countries

**Discussion**

Responders of this self-reported survey described a significant discrepancy between the resources and services available respectively to HICs and LMICs to adequately care for major trauma patients. Shortages ranged over a wide range of items, from consumables to analgesia, imaging to specialist services, both pre-hospital and in-hospital. This study showed lack of prehospital services for 79% of LMIC settings versus 21% of HIC settings. This echoes existing literature. Although the finding of lower resource availability in LMICs was not altogether surprising, the sheer extent of the reported findings was. If these

findings are anything to go by, it seems unlikely that the evidence-based reference standards recommended by NICE would apply in LMICs (but will be easily achieved by the HICs). This is problematic seeing that around 82% of the world's population live in LMICs, and that this region has a substantial burden of trauma. [5-7,10] Naturally these findings need to be considered within the remit of the study limitations described below. The data visualisation in figure 1 reveals some variables that should be relatively easy to address versus variables that would be more challenging in a resource-restricted setting. Major trauma activation criteria and also major haemorrhage protocols can be very useful in any setting to guide best available care. Often this means considering the reasonable outcomes that can be achieved with the set of given resources and shaping these into guidelines to optimise what is available. It is disappointing to see that these were uncommonly available (even in high-income settings). Tranexamic acid is fairly inexpensive and linen sheets can be used to bind the pelvis. Arguably blood products and staffing a round-the-clock surgical service is more challenging. What was also very interesting was that despite a larger proportion of LMIC respondents working in private institutions, resources were still reported as insufficient. This is a bit harder to explain, however, if one considers that fewer LMIC respondents were specialists compared to HIC respondents, the difference (at least for the private sector) could be described as non-adherence to best practice due to knowledge gaps and lack of specialised training. The growth of emergency medicine as a specialty in LMICs would likely present an opportunity for LMICs to better balance available resources with the best available evidence.

The 'sometimes' category was of particular interest. In essence it referred to the variable availability of a resource or service. It is arguable that 'sometimes' would be as detrimental as 'never' due to the unpredictability it represented. It would be difficult to establish local guidance based on unpredictable resources or services.

There are of course some limitations to this study. The sample is small and response rates were lower than expected. It is possible that a larger study could reveal a type one error in the findings. That said, the findings seem to confirm anecdotal evidence. The size of the difference between LMIC and HIC responses are also quite revealing, making it difficult to find an argument to challenge the findings. Trauma care is a multi-system package which one cannot practice one part of without also needing to practice the other. Better evidence for dealing with major trauma in a variety of income settings are required in order to provide reference standards that are achievable within the larger context of the world's

population. We did not specifically evaluate the survey results against the existing World Health Organization's Guidelines for Essential Trauma Care, mainly as it was published back in 2004.[11] The NICE guidelines include more recent, evidence-based guidance in trauma care and it was decided, on balance, to be the better reference. The 'sometimes' category introduced some uncertainty into the responses. Unlike 'always' and 'never', this category does not present a clear definition of its meaning. Although our intention was that it represented variable availability of resources or services, this may have been differently interpreted by participants. While the survey asked the participants to state where they worked majority of the time, it is possible that some of the participants were from a HIC but worked in a LMIC and vice versa.

**Conclusions**

Resource restriction is a major concern in the care for major trauma patients in LMICs. Current accepted reference standards provide little wiggle room for clinicians working in these difficult circumstances. It does not take the resource restrictions that apply to the vast majority of the world's injury patients into account. More research is required to describe the problem of resource restrictions in LMICs, and then working out how to overcome it.

**Dissemination of results**

The findings of this study was presented as a poster at the African Conference on Emergency Medicine in Cairo (November 2016).

**Author contributions**

AA, CH and SRB made substantial contributions to the conception of the work. AA was responsible for data acquisition. AA, CH and SRB was responsible for data analysis and interpretation. AA, CH and SRB drafted the work and revised it critically for important intellectual content. AA, CH and SRB approved the final version to be published, and agreed to be accountable for all aspects of the work.

**Conflict of interest**

SB is an editor of this journal. He was not involved in the peer review process of this manuscript. The author(s) declare no further conflict of interest.

**Acknowledgements:**

We wish to acknowledge the participants who generously volunteered to take part in the interviews for this research.

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**Data supplement (Appendix A)**

**Study questionnaire**

**About you**

1. Please provide your age in years: _____

2. Please indicate your gender

    a. Male

    b. Female

    c. Decline to state

3. Which healthcare provider group do you belong to?

    a. Pre-hospital worker

    b. Nursing

    c. Non-physician (clinical officer/ physician assistant)

    d. Physician- generalist

    e. Physician- specialist

    f. Other: _____

4. Are you currently in training in this provider group?

    a. Yes

    b. No

5. Please indicate your level of **post training** acute care experience within this provider group

    a. Less than 5 years

    b. 5 to 10 years

    c. 11 to 15 years

    d. 16 or more years

6. Name the country in which you work most of the time in this past year: _____

7. What setting describes your place of work in the above country best?

    a. Ambulance/ prehospital service

    b. Primary care hospital/ community clinic (includes family medicine and/ or nurse-led primary care)

    c. Secondary care/ Regional hospital (includes basic specialist care)

    d. Tertiary/ Teaching hospital (includes sub- and super-specialist care)

    e. Other: _____

8. What business model describes your place of work best?

    a. Privately funded NGO/ charitable

    b. Privately funded commercial

    c. Public/ state/ government funded

    d. Hybrid funding (private/ public funded)

9. What is the place called where emergencies are received and treated in your setting?

    _____

**Prehospital questions**

1. Do you perform any prehospital work?

    a. Yes

        <survey automatically continues to prehospital questions>

    b. No, there are no prehospital service in region where I work

        <survey automatically continues to in-hospital questions>

    c. No, there is a prehospital service in the region where I work, but I do not perform any prehospital work

<survey automatically continues to in-hospital questions>

2. Does your setting have a national or local emergency contact number (i.e. dedicated phone number for members of the community to activate prehospital services/ fire brigade/ police)

    a. Yes, although there is no national emergency contact number, we have a local emergency service contact number (optional: explain in comments box below)

    b. Yes, there is a national emergency contact number

    c. No (optional: explain in comments box below)

    <survey allows free text comments for this section>

3. Please indicate access to the following within your ambulance/ prehospital environment?

    <options: Always/ Sometimes/ Never/ Don't know>

    a. Prehospital triage protocol

    b. Prehospital pre-arrival major trauma notification protocol

    c. Prehospital airway management guidelines

    d. Prehospital chest injury management guidelines

    e. Prehospital haemorrhage management guidelines

4. Please indicate access to the following drugs within your ambulance/ prehospital environment?

    <options: Always/ Sometimes/ Never/ Don't know>

    a. Oxygen

    b. IV fluids- crystalloids

    c. IV fluids- colloids

    d. blood products

    e. Tranexamic acid (Cyclokapron®)

f. Analgesia: Morphine

g. Analgesia: Ketamine

h. Analgesia: other (provide other available drug(s) of choice in comments box below)

<survey allows free text comments for this question>

a. Rapid sequence induction sedative agents (provide available drug of choice in comments box below)

<survey allows free text comments for this question>

b. Rapid sequence induction muscle relaxant agents (provide available drug of choice in comments box below)

<survey allows free text comments for this question>

c. Drugs: continuous sedation (provide locally available drug of choice in comments box below)

<survey allows free text comments for this question>

5. Please indicate access to the following equipment within your ambulance/ prehospital environment?

<options: Always/ Sometimes/ Never/ Don't know>

a. Monitoring: Saturation

b. Monitoring: Three lead ECG

c. Monitoring: Non-invasive blood pressure

d. Monitoring: Temperature

e. Laryngoscope

f. Ultrasound

g. Pelvic binder

h. Splints for upper limb fractures

i. Splints for knee and below knee fractures

j. Traction splints for femur fractures

6. Please indicate access to the following disposables within your ambulance/ prehospital environment?

<options: Always/ Sometimes/ Never/ Don't know>

a. Oxygen face mask

b. Rigid cervical collars

c. Airway adjuncts (oropharyngeal/ nasopharyngeal airways)

d. Endotracheal tube

e. Supraglottic airways

f. Thoracostomy (chest drain) set

g. Tourniquets

h. Dressings

i. IV cannula

j. Intra-osseous needles

k. IV fluid giving set

**In-hospital questions**

2. Do you perform any in-hospital work?

a. Yes

<survey automatically continues to in-hospital questions>

b. No, I do not perform any in-hospital work

<survey automatically continues to thank you webpage>

3. Please indicate access to the following within your direct hospital environment?

<options: Always/ Sometimes/ Never/ Don't know>

a. Dedicated area for treatment of emergencies

b. Triage service for patients on arrival

c. Major trauma activation protocol

   (not major incident activation protocol; a major trauma activation protocol refers to activation of predefined specialist teams- e.g. intensivists, surgeons, radiologists, orthopaedics, etc.- to converge in a single area in the hospital, usually the emergency centre, to acutely care for a major trauma case or cases)

d. Massive transfusion protocol

   Massive transfusion is arbitrarily defined as the replacement of a patient's total blood volume in less than 24 hours, or as the acute administration of more than half the patient's estimated blood volume per hour (trauma.org)

e. Airway management guidelines

f. Chest injury management guidelines

g. Fracture management guidelines

h. Head injury management guidelines

i. Operating theatre

   (for 24-hour access select always, for less than 24-hour access, or access by transfer select sometimes, for no theatre, select never)

j. Intensive care/ high care service

   (for 24-hour access select always, for less than 24-hour access, or access by transfer select sometimes, for no theatre, select never)

k. Orthopaedic specialist service

   (for 24-hour access select always, for less than 24-hour access, or access by transfer select sometimes, for no, select never)

l. Neurosurgical specialist service

(for 24-hour access select always, for less than 24-hour access, or access by transfer select sometimes, for no, select never)

m. Cardiothoracic specialist service

(for 24-hour access select always, for less than 24-hour access, or access by transfer select sometimes, for no, select never)

n. Vascular surgery specialist service

(for 24-hour access select always, for less than 24-hour access, or access by transfer select sometimes, for no, select never)

4. Please indicate access to the following drugs within your hospital environment?

a. Oxygen

b. IV fluids- crystalloids

c. IV fluids- colloids

d. blood products

e. Tranexamic acid (Cyclokapron®)

f. Analgesia: Morphine

g. Analgesia: Ketamine

h. Analgesia: other (provide available drug of choice in comments box below)

<survey allows free text comments for this question>

i. Rapid sequence induction sedative agents (provide available drug of choice in comments box below)

<survey allows free text comments for this question>

j. Rapid sequence induction muscle relaxant agents (provide available drug of choice in comments box below)

<survey allows free text comments for this question>

k. Drugs: continuous sedation (provide locally available drug of choice in comments box below)

<survey allows free text comments for this question>

5. Please indicate access to the following equipment/ service within your hospital environment?

a. Monitoring: Saturation

b. Monitoring: 3 lead ECG

c. Monitoring: Non-invasive blood pressure

d. Monitoring: Invasive Blood pressure

e. Monitoring: Temperature

f. Laryngoscope

g. Mechanical Ventilator

h. Tests: point of care blood glucose measurement

i. Tests: full/ complete blood count

j. Tests: coagulation profile

k. Tests: renal function

l. Tests: lactate

m. Tests: blood gasses

n. Imaging: Ultrasound

o. Imaging: Plain film radiology: x-rays

p. Imaging: Computed Tomography Scanner (CT-scan)

q. Imaging: Magnetic Resonance Imaging

r. Imaging: LODOX scan

s. Imaging: Fluoroscopy imaging (swallows, enemas)

t. Plaster of Paris and other forms of cast material

u. Pelvic binder

v. Splints for upper limb fractures

w. Splints for knee and below knee fractures

x. Traction splints for femur fractures

6. Please indicate access to the following disposables within your hospital environment?

a. Oxygen face mask

b. Endotracheal tube

c. Supraglottic airways

d. Thoracostomy (chest drain) set

e. Tourniquets

f. Dressings

g. IV cannula

h. Intra-osseous needles

i. IV fluid giving set

**Data Supplement (Appendix B)**

Table 2: List of countries that participated in the study

| |
|---|
| Australia |
| Austria |
| Barbados |
| Belgium |
| Botswana |
| Cameroon |
| Canada |
| Chile |
| China |
| Colombia |
| Denmark |
| Dominican Republic |
| Ethiopia |
| Fiji |
| Finland |
| France |
| Germany |
| Ghana |
| Iceland |
| India |
| Indonesia |
| Iran |
| Iraq |

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| Ireland |
| Italy |
| Japan |
| Kenya |
| Libya |
| Madagascar |
| Malawi |
| Malaysia |
| Namibia |
| Netherlands |
| New Zealand |
| Nigeria |
| Oman |
| Hong Kong |
| Philippines |
| Qatar |
| Rwanda |
| Saudi Arabia |
| Sierra Leone |
| Singapore |
| Somalia |
| South Africa |
| South Korea |
| Sudan |
| Swaziland |

| |
|---|
| Sweden |
| Switzerland |
| Taiwan |
| Tanzania |
| Turkey |
| Uganda |
| UK (United Kingdom) |
| United Arab Emirates |
| USA (United States of America) |
| Vietnam |
| Zambia |

## Part C: Addenda

### Journal instructions to author

The guidance for authors for the African Journal of Emergency Medicine can be found at the following link: https://www.elsevier.com/journals/african-journal-of-emergency-medicine/2211-419X/guide-for-authors

**Consent form**

Describing and comparing the availability of acute care resources to treat major trauma in different income settings: a self-reported survey of acute care providers at the 2016 International Conference on Emergency Medicine

**Consent**

<Invitation notification and first webpage of survey>

Dear prof/ dr /sr/ sir/madam,

We are conducting a study, which aims to describe and compare the availability of acute care resources to treat major trauma in different income settings.

You have been selected to participate due to you agreeing to be contacted in this regard during registration. Your participation is entirely voluntarily and non-participation will not have any negative consequences. There are no monetary benefits for participation. Please follow the personalised link to an online questionnaire. It should take less than 15 minutes to complete the questionnaire. The completion of the questionnaire will serve as implied consent. The online system will ensure questionnaires are returned anonymously; however, the system will provide us with a list of non-responders to enable us to send frequent reminders. The survey will be active till 6 May 2016. Access to the results will be limited to the research team.

The study has been approved by the Human Research Ethics Committee the University of Cape Town (Ref XXX). They can be contacted at: Tel: 021 406 6338 or Fax: 021 406 6411

Please contact us if anything is unclear.

Kind regards,

Principle investigator: Stevan R Bruijns

Division of Emergency Medicine, University of Cape Town

Email: stevan.bruijns@uct.ac.za

Phone: +27760467967

On behalf of the research team: AZ Alibhai, C Hendrikse

**ICEM Local Organising Committee Approval**

**Acknowledgements**

I would, first and foremost, like to acknowledge how much respect I have for researchers who take the time and effort to not only undertake research but to publish it for the greater good of the world. The process of completing this dissertation has been long and difficult, but with important lessons that I will carry forward through out my career, and more importantly, my life.

I would like to thank my supervisors Stevan and Clint, for their constant encouragement and endless support during this process for without them I would not have been able to understand or complete this work.

I am appreciative to the ICEM committee for giving me the permission to conduct the research at the ICEM conference.

I would like to thank the participants who took the time to fill out the questionnaire.

**Research protocol**

**Describing and comparing the availability of acute care resources to treat major trauma in different income settings: a self-reported survey of acute care providers at the 2016 International Conference on Emergency Medicine**


Principle investigator: Stevan R Bruijns (Division of Emergency Medicine, University of Cape Town)

MMed candidate: Alyshah Z. Alibhai (Division of Emergency Medicine, University of Cape Town)

Co-investigators: Clint Hendrikse (Division of Emergency Medicine, University of Cape Town)

Ramadhan Chunga (MMed, Division of Emergency Medicine, University of Stellenbosch)

Paul B Muganda (MMed, Division of Emergency Medicine, University of Stellenbosch)

Johann G Beukes (MMed, Division of Emergency Medicine, University of Cape Town)


This study is one of four surveys, with similar methodology, by the same study team regarding self-reporting on resource availability. It is planned to be collected at the April 2016 International Conference on Emergency Medicine to be held in Cape Town. The other three projects concern resources involved with the acute care of acute coronary syndrome, stroke and sepsis.

**Abstract**

Introduction

Trauma is an important cause of mortality globally. [1] Mortality rates have been shown to be much higher in low to middle income countries than high income countries. Much can, and still needs to be done to strengthen the prevention and treatment of injuries in the former settings. The aim of this study is to describe and compare the availability and distribution of resources available for acute care of trauma when grouped into low, middle low, middle high and high income setting categories- using the Major trauma: assessment and initial management NICE guideline- as self-reported by delegates attending the April 2016 International Conference on Emergency Medicine.

Methods

This study will be conducted as a self-reported, cross-sectional survey, at the 2016 International Conference of Emergency Medicine. SurveyMonkey Inc. (Palo Alto, California, USA, www.surveymonkey.com), a web-based e-Survey client, will be used to conduct the survey. All health care provider delegates will be eligible for inclusion (approximately 2200 delegates from over 60 countries are expected to attend). Variables regarding equipment and resource requirements were taken from the Major trauma: assessment and initial management NICE guideline. These variables will be arranged in terms of their ranked strength of evidence, while responders will be grouped into the World Bank's low, middle low, middle high and high income setting categories, based on their country of practice. Descriptive statistics will be used to describe the data.

Ethics

Participation in the survey will be voluntary and confidentiality will be maintained. The e-Survey client will ensure anonymous completion of the survey with the back-end, which is not accessible to the study team to guarantee anonymity. The participants will not be reimbursed for participation in the survey.

Conclusion / Dissemination

The findings will be shared with the International Federation for Emergency Medicine executive committee. A peer-reviewed publication of the study is also anticipated.

**Describing and comparing the availability of acute care resources to treat major trauma in different income settings: a self-reported survey of acute care providers at the 2016 International Conference on Emergency Medicine**

**Introduction**

Trauma, or injury is an important cause of mortality globally. [1] According to the World Health Organization (WHO), road traffic injury account for 1.3 million deaths annually.[1] It was the ninth leading cause of disability in 2004, and will rise to the third leading cause of disability worldwide by 2030.[1] Injury from unintentional trauma worldwide leave over 45 million people each year with moderate to severe disability.[1] Road traffic injury and other forms of trauma (intentional and unintentional) have become major health problems throughout the world and especially in low to middle income countries.[2-4] Injuries are a neglected epidemic in low to middle income countries with more than 90% of injury deaths occurring here.[5,6] Preventive efforts in these settings are often non-existent and healthcare systems are unprepared to meet the challenge this poses. [5,6]

Disparities with regards to the level of care offered by countries, depends on their economic status. [5,6] Mortality rates have been shown to be higher in low to middle income countries compared to high income countries. Much can, and still needs to be done to strengthen the prevention and treatment of injuries in the former settings. [7,8] To address the on-going global burden of trauma and injuries, we need to first establish what resources are currently available to effectively treat injuries in resource challenged settings.

The National Institute for Health and Care Excellence (NICE) provides evidence-based guidelines for a variety of conditions. Their main focus is to provide treatment guidelines to the United Kingdom's National Health Service; however, their guidelines are widely considered the reference standard of care. [15] There is currently no authoritative universal guideline for major injury or trauma care. The NICE is in the final stages of approving their guideline, Major trauma: assessment and initial management. [9]

The aim of this study is to describe and compare the availability and distribution of resources available for acute care of trauma when grouped into the World Bank's low, middle low, middle high and high income setting categories - using the Major trauma: assessment and initial management NICE guideline- as self-reported by delegates attending the April 2016 International Conference on Emergency Medicine.[9,10] The conference draws a niche group of delegates, most often from academic, educational or leadership

positions within their local settings. It is this quality that will allow the collection of a reasonable data set that can be used to gauge resource availability against an accepted, international, treatment reference standard. It is hoped that this study will aid in hypothesis generation for further research into resource availability regarding frontline treatment of trauma in low to middle low income settings.

**Objectives:**

Drawing from a diverse study population, International delegates attending the 2016 International Conference on Emergency Medicine (ICEM) will provide answers regarding their usual work setting- using a self-reported survey- on the availability and distribution of resources used in the management of major trauma; and then categorised according to the World Bank's low, middle low, middle high and high-income groupings accordingly. [10] In this light the objectives are:

1. To provide a general description of the existence/ availability/ accessibility of major trauma acute care guidelines within World Bank income groupings

2. To provide a general description of equipment (drugs, equipment and disposable materials) available for the acute care of major trauma patients within World Bank income groupings

3. To provide a general description of supportive resources (cardiology service, coronary care unit, CT and primary coronary intervention) available for the acute care of major trauma patients within World Bank income groupings

4. To compare the inter-rater description of availability and distribution of resources available for care of major trauma patients within and between the World Bank income groupings.

    a) Sub objective: To compare the inter-rater description of availability and distribution of resources available for care of major trauma patients within and between World Health Organisation regions

**Methodology:**

Study Design: A self-reported, cross-sectional survey- which have been created de novo- will be conducted using an institutional subscription to the web-based e-Survey client, SurveyMonkey Inc. (Palo Alto, California, USA, www.surveymonkey.com).

Characteristics of the study population: The 2016 ICEM is the official conference of the International Federation for Emergency Medicine. The federation represents more than sixty national emergency medicine societies across the globe. [11] It is considered as "the most active, broad-based, international organization dealing with international EM [emergency medicine] development issues". [12] Its biennial conferences attract around 2200 delegates and are the largest international gatherings of acute care clinicians, nurses and prehospital staff in the world. Delegates tend to be representatives from member, national emergency medicine societies as well as academics, emergency medicine trainees and those with an interest in global emergency medicine development. Representation tends to be wide and includes a good spread of delegates from low, middle low, middle high and high-income settings. Approximately 2500 from over 60 countries are expected at the 2016 conference. This assumption is based on previous conference attendance; 2200 delegates from 60 countries attended the 2012 Dublin, Ireland conference and 2280 delegates from 67 countries attended the 2014 Hong Kong, China conference. For the 2014 conference 25% of delegates were from low to middle income countries and 48% were from the East Asia region. [14] The expectation is that African attendance would be similarly affected given the African host for 2016. To further bolster delegate attendance from low and middle low settings, sponsorship initiatives have been put in place by the local organising committee. In addition, given that South Africa will play host, it is expected that the conference will at least be more accessible to delegates from low and middle low settings within the sub-Saharan African region. With a target response rate of 50-60%, the sample size is estimated to be around 1200 completed surveys.

Recruitment and enrolment: All prospective delegates have to consent to be approached for research during registration for the conference. [13] Only delegates who have consented will be approached during the conference via email and/ or using the conference smartphone application (through a directed study participation notification) to take part in the survey. All delegates who are acute care providers (medical, nursing or pre-hospital staff) will be eligible for recruitment. Trade and non-clinical delegates will be excluded-a link in the survey will proceed to the end of survey if participant clicked on non-clinical/trade delegate. A link from the email/ application notification will provide access to first an informed consent (as a preamble to the survey) and second the survey. Participants will have to click to agree continuing to the survey. Hence, participating in the survey will serve as implied consent.

This survey will be promoted on one of the four days of the conference (with the other related three surveys promoted on the other three days respectively). It will then remain open for two weeks following the conference. Reminders will be provided during the conference and then every three days following the conference for the remainder of the time. The e-survey client will be set to not send reminders to delegates who have completed the survey. During the conference, delegates will be encouraged to complete the survey during the sessions. A QR-code linking delegates' smart devices to the survey will be circulated on at the conference on the notification screens and placed at the African Federation of Emergency Medicine trade desk to encourage delegates to complete the survey. The e-Survey client will be set to allow only one submission from the same device to avoid multiple submissions from the same delegate. It is accepted that the same delegate would still be able to submit survey from another device. This would be difficult to police electronically and is a limitation of using electronic surveys for data collection. It is however expected that the vast majority of (if not all) participants will refrain from completing the survey multiple times. The research teams will certainly not encourage it. Data sets will be imported from the backend of the e-Survey client on a spread sheet using Microsoft Excel ® (Microsoft Corporation, Redmond, WA). The e-Survey client will ensure anonymous completion of the survey with the back-end (which is not accessible to the study team in the planned full anonymous setting) allowing reminders to be sent to non-responders.

Research procedures and the survey: The provisional study survey is provided in Appendix B. It has been pretested for readability and content by the six members of the overall study team and eight members of the emergency medicine division research committee. Further development following approval will include pilot testing the survey with international and local emergency medicine clinicians (n=5), emergency nurses (n=5) and prehospital staff members (n=5). These providers will be asked to complete the survey and then to assess it with regards to adequacy, suitability, duration and organisation. Following feedback, modifications will be made to improve the survey. The final survey tool will be published along with the findings.

The survey was created de novo with (as informed by Baelani, et. al.'s work) for the study variables regarding equipment and resource requirements taken from the 2015 NICE guideline on Major trauma: assessment and initial management. [9,16] This document is currently in its final draft and planned to be released in February 2016. The survey

captures demographic details of respondents: age, gender, experience (years), country, sector (public, private, mixed), discipline (medical, nursing, prehospital), and details of their place of work (out of hospital, primary, secondary or tertiary care). Equipment and supportive resources availability requires one of the following answers per variable: always, sometimes, never and don't know. The survey has been drafted to follow the patient journey to allow a practical approach when being completed. Participants will be able to skip sections that do not apply to their scope of practice.

Statistical analysis: The study team will use SPSS version 22 (IBM Corp, Armonk, NY) for analysis. Descriptive statistics will be used to describe individual variables. Datasets where sections have been skipped due to participant scope will be included in the final sample. Calculations will be adjusted accordingly to accommodate variable sample size differences. The mean will be used to express central tendency and standard deviation to describe spread for continuous variables (age). Categorical variables, such as gender, healthcare provider group, experience, place of work, business model, resource availability, etc. will be expressed as proportions. Histograms and/ or frequency tables will be used to present categorical data visually. Resource and treatment variables will be arranged in terms of their ranked strength of evidence according to the 2015 NICE guideline on Major trauma: assessment and initial management. [9] Inter-rater agreement within and between the various income and regional categories will be assessed using weighted Cohen's Kappa.

**Ethical Considerations:**

Benefits and Risks: The findings will provide an overview of resource availability, but not a definitive answer. As very little data exist on resource availability in LMICs this will provide a guide on where to focus further research into resource availability. Embarrassing a specific participant or facility is a potential concern. An anonymous sample will help although not completely negate the risk of retrospectively identifying a participant or facility by association, however there is no specific interest in individual delegates or even individual countries. Findings will be reported in categories (either according to the income group or the World Health Organisation region). This is clearly stated in the consent (Appendix A).

Consent: Participation is voluntary. Delegates identified to participate in the survey will have already agreed to be approached for research during the conference registration

process. Conference registration includes a section which the delegate has to agree to or not that reads as follow:

"The gathering of so many international emergency care workers in Africa is unprecedented, and as such poses an important opportunity for research during the conference. All research conducted during the conference will have received permission from the conference scientific committee. This permission is not in place of the requirement for Ethical (IRB) approval for individual studies. South Africa's Protection of Personal Information Act regulates the processing of personal information and requires consent from an individual to make use of demographic as well as corresponding information. I agree to be approached to take part in research around the ICEM 2016 conference. I understand that this consent does not imply my consent to participate in individual studies: □ Yes/ □ No" [13]

A link from the email/ application notification will provide access to first an informed consent (as a preamble to the survey) and second the survey. Electronic consent will be taken prior to commencing the survey (see Appendix B). Participants will have to click to agree before continuing the survey.

Confidentiality: The survey will make use of a fully anonymous participant setting. The e-Survey client will ensure anonymous completion of the survey with the back-end (which is not accessible to the study team) allowing reminders to be sent to non-responders.

Reimbursement: Participants will not be reimbursed for participation.

Dissemination: This study is being conducted as an MMed degree and a thesis will be submitted to the University of Stellenbosch for review upon completion. Findings will be shared with the International Federation for Emergency Medicine executive committee. A poster presentation of findings is anticipated at the African Conference on Emergency Medicine to be held in Cairo, November 2016. This study is conducted as an MMed Dissertation, and a thesis will be submitted to University of Cape Town (UCT), for review upon completion.

Limitations:

1. The inclusion of only ICEM 2016 will, due to respondent clustering, introduce a selection bias. In theory, the results may be an overestimate of the true picture since delegates from underserved rural hospitals (which make up a significant part of health care services) may

be underrepresented. At the 2014 ICEM conference, 25% representation came from low to middle income settings, with a 48% regional representation. Interpreted in the African context, it is a huge contribution to delegates in the low to middle income setting, however, this will be difficult to predict in advance-and results will need to be interpreted, keeping this bias in mind. The conference organisers will attempt as much as possible, to ensure attendance from an equal proportion of delegates from high income and low-middle income countries, however, this is not guaranteed and may affect the results if any of the groups is significantly larger than the other.

2. Since the survey will be evaluating the availability of material resources only, it will underscore the shortage of trained health care providers in the low to middle income setting. Keeping this in mind, the main purpose of providing material is for hypothesis generation. More studies can be done, at a later time, to provide more specific insight in to human resources.

3. Data collected from surveys may lack the depth and detail on the specific research topic, however, this study is meant to provide a snapshot of the availability of resources across different countries (i.e. laying a foundation on which more studies can be built from). Another factor influencing results is "poor response rate". A similar study done at a conference in Kenya (2011) to describe sepsis resources, had a 74% response rate. Regular reminders (as mentioned earlier) will be sent to attempt to keep response rates as high as possible.

4. Some of the questions may be misunderstood by the respondents-despite pre-testing the survey. Language barriers may also contribute to this problem. The conference will be conducted in English and all the promotional material are in English. It is hoped that a large proportion of the participants will understand a sufficient amount of English to be able to adequately complete the survey.

5. Participant fatigue-there may be other studies done at the conference as well and this may lead to a delegate exhausting him/herself and not answering well.

**Project Timeline:**

| 2015-16 | DEC | JAN/ FEB | APR | MAY | JUN | JUL |
|---|---|---|---|---|---|---|

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|---|---|---|---|---|---|---|
| Departmental Research Committee | **X** | **X** | | | | |
| Ethics | | **X** | | | | |
| Data Collection | | | **X** | | | |
| Transcribing of Data | | | **X** | | | |
| Data Analysis | | | **X** | **X** | **X** | |
| Compilation of findings | | | | **X** | **X** | **X** |
| Presentation of findings | | | | | | **X** |

**Budget**

The cost of the study will be borne by the investigators-estimated as seen below:

| | |
|---|---|
| **Personnel Compensation** | **R 0** |
| Principal Investigator | R 0 |
| **Consulting services** | **R 0** |
| Statistical services | R 0 |
| **Travel** | **R 500** |
| **Conference registration** | **R 0** |
| **Equipment & Furniture** | **R 0** |
| Computer | R 0 |
| **Other** | **R 200** |
| Telephone, cell phone, fax | R 100 |
| Internet & e-mail | R 100 |
| Printing, copying & binding | R 1000 |
| Ethics committee fee | R 0 |
| **Total costs** | **R 1900** |

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